

# Analysis For The Development Of Case-Method-Based Electronic Teaching Materials For Advanced Calculus Courses

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**Abstract.** This research is part of the revitalization of the case method-based learning device. The purpose of this research is to develop a case-based textbook for learning calculus. The case method is used to encourage students to apply calculus concepts in real-life situations. This book is designed to help students hone and improve critical thinking skills for problem solving, communication skills, collaboration, and creativity. All of this is in accordance with the demands of the 21st century. The 21st century is where technology plays an important role, including in the world of education. The book development process involves identifying the calculus curriculum, selecting relevant cases, and combining theory with case examples. Evaluation of books is done by involving students in their use. The results showed that this case-based book was effective in increasing students conceptual understanding and problem-solving skills, as well as their learning motivation.

**Keywords:** Development, Case Method, Teaching Materials

## 1 Introduction

Education plays a critical role in determining a country's progress and preparing future generations. In this case, Theodore Meyer's view of genre states that education is an effort to prepare human resources (HR) in order to achieve a better and more meaningful life, which is very relevant [1] [2], education is an initiative to improve quality learning, strengthen ability and expertise, form positive character, prepare the next generation's successor nation, and encourage participation in the education process [3]. This is meaningful because quality higher education will produce competent human resources and will have a positive impact on the overall progress of the country

In Indonesia itself, developments in education are ongoing, and the government continues to strive to improve quality education in Indonesia. A good system of education will create superior human resources and help a country move forward [4][5]. The higher the quality of

education in a country, the more forward that country will be. On the contrary, the poorer a country's educational system, the slower it will develop. Entering the 21st century, education in Indonesia is becoming something exciting when we realize the strong influence of the current wave of globalization in the 21st century that is progressing technology in the Indonesian education system [6].

Sector education in Indonesia is currently working to mitigate the significant COVID-19 pandemic. One step remedy implemented by the government is the launch of the Independent Curriculum. Draft This Merdeka Curriculum refers to a change in approach to learning where teaching materials become more diverse, making it possible for participants to have more time to understand concepts and develop their competence. In this curriculum, teachers are given flexibility to choose various teaching tools so that learning can be tailored to the needs and interests of each participant. [7]

The main goal of the Independent Curriculum is to ensure that participant students don't just understand theories and concepts taught but are also capable of applying this knowledge in deep real-world situations [8]. Thus, the Independent Curriculum aims to create a generation of students who are not only ready to enter the world of work with strong competencies but also have high moral and ethical values when they interact with society.

The curriculum in higher education is realized in the Independent Campus Program. At universities, there are differences in the application curriculum. With the Independent Campus Program, students are given the chance to learn something outside of the study program they are currently studying. Many students do work practice (internships), student exchanges, research, independent and entrepreneurial projects, become teaching assistant lecturers, and also carry out Real Work Lectures (KKN) to be able to build villages. Not far different from Medan State University, as one college high that prints Human Resources, it is always consistent in enhancing quality education and HR output. One of his efforts is to implement the KKN curriculum and the case method approach to learning.

The case method is one approach to learning that emphasizes discussion to solve a case related to the material learned [9]. This approach helps students train as well as increase their skills to think critically, be creative in solving problems, and improve communication and collaboration. Learning currently has the Curriculum Framework Indonesian National Qualifications (KKN) as the base curriculum, all at once applying the approach method recognized case method in a way wide in education. Although there is an aspect important that is necessary to be noticed, that is revision, still teaching materials need to be carried out to suit the approach method applied in the cases

The survey results from the Medan State University monitoring and evaluation institute stated that Almost 100% of the RPS collected by lecturers use the Case Method approach. How ever results research from lecturers and students themselves especially scope major mathematics that teaching materials used still the old one. As example in Study calculus, teaching materials used Still focuses on old teaching materials that have not been revised. Teaching materials yet implement Case Method approach even though it has been implemented KKN curriculum. move from This condition is a researcher who also teaches class calculus moved to revitalize device learning calculus and the focus of this article is Revitalization Calculus teaching material. Calculus is courses that come out in semester 1 and become prerequisites in some

other courses, so that students can know meaningfulness from material provided. \_ Material provided served directly \_ displays case case in life real

## 2 Reasearch Method

The method used in the development of this teaching material are ADDIE Development method by integrating approach qualitative. Approach qualitative will help researcher analyze and understand in more depth How development based teaching materials method case influence learning and teaching [10][11] Following is explanation the steps:

1. Analysis (Analysis): ADDIE Method: Identification objective the learning you want achieved by development based teaching materials method case. Create a plan to collect quantitative and qualitative data that can provide understanding about needs and problems existing learning .Approach Qualitative : Use method qualitative like interview or discussion groups with teachers and participants learning to understand better \_ challenge learning encountered and their related preferences \_ method case .
2. Design (Design): ADDIE Method: Designer based teaching materials method case , incl election case , material support , and tools learning . Make sure design the according to purpose learning that has been done determined . Approach Qualitative : Do it interview or discussion groups with teachers and participants learning to get input about design teaching materials , what the cases are like relevant and challenging .
3. Development (Development): ADDIE Method: Create a prototype teaching materials , incl cases and materials supporters . Test it out this prototype with the group small participant learning . Approach Qualitative : During testing , do observation to How participant learning interact with teaching materials and provide them chance for them to provide bait come back in form interview or discussion .
4. Implementation : ADDIE Method: Implement based teaching materials method case in context appropriate learning .Approach Qualitative : Observe implementation teaching materials in situation learning actually . Do interviews or observations to instructors and participants learning to understand How teaching based method case impact on the learning process .
5. Evaluation (Evaluation): ADDIE Method: Evaluation teaching materials based on objective learning that has been done determined . Use quantitative data to measure performance participants and qualitative data to understand perception and experience participants .Approach Qualitative : Do it interview in depth with participants learning to get view deep about How based teaching materials method case influence their understanding and abilities in solution problem .

Furthermore Conducted qualitative data analysis to identify areas that need repair in teaching materials as well as a deeper understanding of how participants experience learning-based method case.and renew teaching materials based on feedback and understanding developed from participants and instructors. By combining the ADDIE method with a qualitative approach, researchers can obtain a deeper understanding of how a method-based teaching

materials case influences learning and teaching in a practical way, as well as give the basis for updates on sustainability based on findings from empirical research.

### **3 Result and Discussion**

#### **3.1. Result**

This research is part of the revitalization device learning case-based method. One device for learning is teaching materials. Special device learning has been used all this time for Study Calculus by Edwin J. Purcell, Koko Matono, Handbook of Calculus. The work of the lecturer team that has not yet been done caught my attention. The case method approach is in accordance with the curriculum in force at Medan State University. As for the results from Suite The stages of developing teaching materials are the following:

##### **(1). Analysis Stages**

At this stage, a number of activities will be done to understand and plan the development of calculus teaching materials. The first thing to do here is carry out needs analysis learning, among them identification of objective learning to be achieved in learning calculus. At this stage, consideration is given to the goal of understanding draft calculus, application draft in real-world situations, and skills solution problems. I got it that this teaching material is needed to be able to help learners understand draft usefulness material in the real world.

Furthermore, there is student analysis. Need to understand characteristics of participants educated in This is the student who will use this teaching material. The considerations include abilities (basic students, level cognitive students), style of existing learning, and all this time. Calculus is one of them. Required courses for some courses have become very important things to master. In reality, in the field, when dealing with student material, students always complained about the difficulty of the material, so from the beginning, they accepted understanding from the lecturer. Deep student learning styles class more often just come. Students tend to utilize their Android when carrying out learning in the class.

The final analysis performed is an analysis of the curriculum. Applicable curriculum: Currently in the Medan State University environment, curriculum independence is maintained while still implementing KKN's duties in learning and integrating the case method approach to each learning activity. After understanding the curriculum and approach implemented at Unimed, the next step is for the researcher to start studying literature to understand theory and the most advanced learning that can be used. This will be very helpful in providing a guide for the development of teaching materials.

After doing some further analysis, researchers started to draw conclusions that previous teaching materials were not yet optimal with the applicable curriculum, especially the case method. Curriculum independence is considered accommodating to the changes and demands of the times where students are required to be capable of following the development of the times, facing global competition, and developing skills according to their needs, so every student is worthy of knowing the meaningfulness and implementation of the material they study. The method is to follow learning based on the case method because the case method is

a teaching and learning approach that emphasizes the use of real-life cases or situations to teach students how to apply theory in practice [12].

This analysis stage provides a solid foundation for the design and development of effective teaching materials. With a good understanding of objective learning, participants learning, needs, and resources available, you can proceed to the stage of design and development of teaching materials with more confidence.

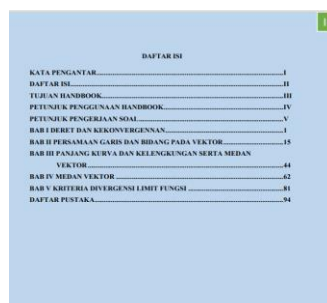
## (2). Design Stages

the stage at which you plan a detailed structure and content for teaching materials. In this stage, you will design How material will be presented, how cases will be used, and how teaching will be organized A number of things that are prepared at this stage are: determining objective learning that is in accordance with RPS calculus; designing case studies that will be used in teaching materials so that they can be applied in a real-world context; and looking for references from a number of sources and methods to serve teaching materials to student participants. In this case, the material follows the RPS agreement that has been prepared together with a team of other lecturers. For materials and selection, the researcher takes from a number of source books, calculus among them from the author, including Edwin J. Purcell, Howard Anton, James Stewart, Bittinger Ellenbogen, and other internet sources. Presentation and teaching materials are planned by blending comics. Basis for selection This development is due to case-method-based teaching materials that will serve case-related material, making the expected delivery of more interesting material for students interests. For touch technology, his researcher chose to use a flipped book for electronic teaching materials developed with the consideration that students use Android more often in their daily lives.

To get support and references for other things, researchers also tried to have a discussion about how to choose the right case for some material. Discussion results obtained: not all the principal discussions can be presented in the context of real life. Specialize in materials for advanced calculus. For this reason, researchers can choose the scope of application of material calculus in the context of real life.

## (3). Development Stages

At this stage, all the series determination material, source reference cases, and integration technology chosen for teaching materials are ready to be compiled. The material presented in calculus teaching materials uses a case-based method, as shown in the table of contents following:



DAFTAR ISI	
KATA PENGANTAR.....	i
DAFTAR ISI.....	ii
TEJAN HANDBOOK.....	iii
PETUNJUK PENGGUNAAN HANDBOOK.....	iv
PETUNJUK PENGIRIAN SOAL.....	v
BAB I BUKTI DAN KONGVERGENSI.....	1
BAB II PERSAMAAN GARIS DAN BIDANG PADA VEKTOR.....	15
BAB III PANJANG KURVA DAN KELENGKUNGAN SERTA MEDAN VEKTOR.....	41
BAB IV MEDAN VEKTOR.....	62
BAB V KRITERIA DIVERGENSI LIMIT FUNGSI.....	81
DAFTAR PUSTAKA.....	94

**Fig 1.** The material presented

Calculus teaching materials with a case-based method are presented by touch-worthy comics. This selection is made to obtain an impression of relaxation in learning and also in the presentation case. At the beginning, every material teaching material is presented in the form of a comic as an introductory stimulus with the hope that studying calculus will become pleasant because it removes the impression of being difficult in studying mathematics [13].

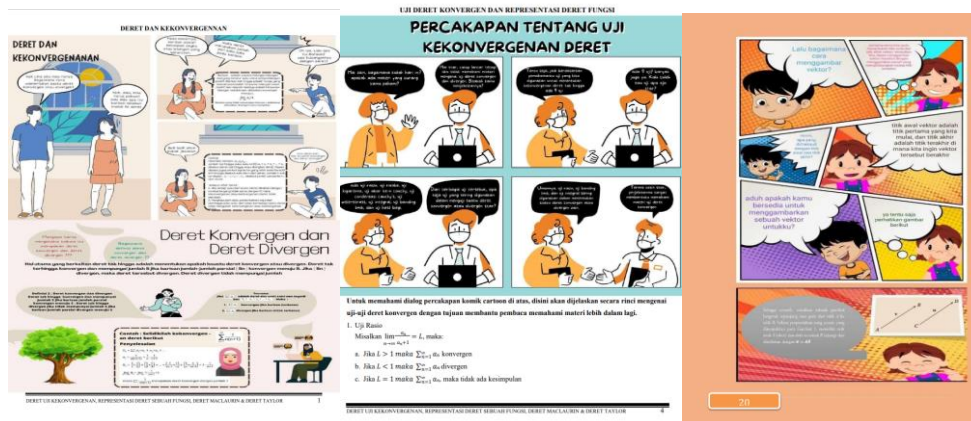


Fig 2. Example Introduction to Each Material

Apart from that, it's deep, giving an example case where every material to make it more interesting is also presented in the form of comics or stories in pictorial form, as in figure 2.



Fig 3. Example exposure material with studies case

Technology used \_ adapt from pixton , comicker and canva . After Teaching materials are prepared for the next time done validation expert material and validation media expert.

**Table 1.** Material Expert Validation Results for Calculus Teaching Materials

<b>Indicator Evaluation</b>	<b>Val I</b>	<b>Val II</b>	<b>Val III</b>	<b>Average</b>	<b>Category</b>
Suitability material	90	85	88	87.67	Worthy
Accuracy Draft	92	88	86	88.67	Worthy
Structure of Matter	85	92	89	88.67	Worthy
Material Completeness	88	90	87	88.33	Worthy
Readability of Material	85	87	84	85.67	Worthy
<b>Conclusion</b>				<b>87.8</b>	<b>Worthy</b>

From table 1 it can be seen results validation material in categories worthy . As for input from the validator , including don't force it material that cannot served in case context real , enough either by providing stimulus through stories comic in form conversation . Don't create long deep conversation One picture Because resulting in small and difficult writing be read

Meanwhile results \_ from validation media experts are as following

**Table 2.** Media Expert Validation Results for Calculus Teaching Materials

<b>Indicator Evaluation</b>	<b>Val I</b>	<b>Val II</b>	<b>Average</b>	<b>Category</b>
Visual Conformity	86	88	87	Worthy
Interactivity	87	85	86	Worthy
Case Quality	84	87	85.5	Worthy
Student Engagement	88	86	87	Worthy
Quality Instruction	85	88	86.5	Worthy
<b>Conclusion</b>			<b>86.4</b>	<b>Worthy</b>

From table 2, it can be seen that results from media validation in categories worthy According to media experts, using not too much monotonous color when using comics, quality pictures that must be better not to break, and comics that can be served with pictures from context are all good ideas.

#### **(4). Stage Implementation**

After validate and perform revision from results input from validator researchers, continue with the next stages. Stages Where calculus teaching materials use a case-based starting method for learning active in class. This process involves researchers as lecturers and student participants learning user-friendly teaching materials to achieve objective learning. The first thing to do at this stage is introduce teaching materials to students. Explain objective learning and how students use teaching materials that use case studies in learning by touch. Teaching materials are also provided for evaluation to measure achievement and objective learning. The

N-Gain result is around 0.4178. Positive N-Gain shows enhancement in understanding or performance for students after exposure to the teaching materials. In this context, these results are telling that the average understanding student experiences enhancement after using use-based teaching materials.

At this stage, the researcher also carried out a discussion and asked questions about the effectiveness of using case method-based teaching materials with students and also gave questionnaire responses to the measurement. The results of this response reflect diverse students' views and experiences of use-based teaching materials in a calculus course. \_ Some students feel that this approach helps them understand draft calculus better, while others may feel challenged by the complexity of given cases. This evaluation can be the basis for improving teaching materials in the future. .

### **(5). Stage evaluation**

This stage is stages Where help in determine success from teaching materials that have been developed . From the data obtained Good in form quantitative nor qualitative , then it can be measured success teaching materials that have been developed . Analysis of the qualitative data obtained during Development stages can continue improve and develop teaching materials to be more effective and efficient according to needs learning .

### **3.2. Discussion**

Based on the results of case method-based teaching development, several findings were obtained. The results of the analysis show that the case method book is really needed to answer the analysis of curriculum needs that apply in the Medan State University environment. The implementation of the case method has been realized; 79% of lecturers at Unimed have received case method training at Unimed, and 85% have applied it to learning activities in the Unimed environment, but there are still implementations that have not been optimal, one of which is teaching materials [14]. The Case Method is able to increase understanding. The ability to increase understanding supports students' skills in problem solving in various situations and also shows a positive influence on learning [15][16]. This condition requires support from parties within the Medan State University environment, including learning implementers, namely lecturers.

The basis for selecting case-method-based teaching materials using comics is consideration of research results that conclude that comics are a learning medium that is interesting, simple, and easy to understand by students so that it makes the teaching and learning process easier, increases learning motivation, and improves students' learning outcomes. [17]. As explained in the background, the calculus course taught by researchers has implemented the case method only visible in the RPS but has not been realized in learning support devices, especially teaching materials. Calculus, which is part of a mandatory course and is introductory material in other courses, really requires in-depth understanding.

In previous research, in order to increase student interest and learning outcomes, researchers have developed augmented reality learning media as a supporting effort for learning tools [18]. Following up on research and responding to policies implemented at Medan State University, researchers developed a need for case-method-based teaching materials. The use of comics is an effort to present mathematics learning that is interesting to read, especially in



presenting cases in learning material. Results: The development of teaching materials went through a validation stage by material experts and media experts.

The results of the validation of teaching materials show an appropriate category with an average indicator score of 87.8, and the validation results of media experts show an appropriate category with an average indicator score of 86.4. Next, the media was tested in a class taught by researchers and showed an increase in learning outcomes after receiving teaching materials, where the N-gain value of the learning outcomes test was 0.4178. After implementation, it is hoped that teaching materials can continue to be developed and become a reference for future research.

#### **4. Conclusion**

Research entitled " Analysis of the Development of Electronic Teaching Materials Based on the Case Method for calculus courses " is A efforts to design , develop , and evaluate innovative teaching materials in context teaching calculus . Based on stages that have been done discussed can previously be concluded that developed teaching materials according to the needs of students who experience it learning with a case method approach and in accordance with the curriculum that applies at Medan State University . Approach technology adapt to the needs of students who use cellphones, then teaching materials are created in form electronic teaching materials using flipped books. After Consolidation of analysis followed by design teaching materials according to selection material , supporting cases , presentation with comics and supporting technology .

Teaching materials that have been The design was validated by the team expert material with results rating 87.8 by category worthy of input One of them is don't force it material that cannot served in case context real , enough either by providing stimulus through stories comic in form conversation . Don't create long deep conversation One picture Because resulting in small and difficult writing read . ,As for results validation media experts are obtained results rating 86.4 by category worthy . The input obtained \_ from media experts include use not too much color monotonous if you use comics , quality picture it has to be better not to break , it doesn't have to every case served comics can be with pictures from context real .

Response results from students is very positive compare straight with the results student evaluation in demonstrated learning \_ The n gain value is 0.4178 which is positive which shows enhancement understanding or performance student after exposed to the teaching materials . In this context , these results are telling that the average understanding student experience enhancement after use based teaching materials case . From the results of the analysis of student responses , it shows that this approach helps them understand draft calculus better , while others may \_ feel challenges with complexity given cases . \_ Students feel teaching materials presented with an approach The case is supported by presentation story in form comic is something interesting novelty \_ interest in read book . By putting it aside how difficult it is material , but already interesting interest in read it . Bait return received \_ from students and colleagues become supporter in improvement and development of subsequent teaching materials .

**Suggestion:**

Based on this research, below are some suggestions for further research in the development of calculus teaching materials based on a method case:

- a. Context-Different Learning: Consider variation in context learning. Further research can explore the effectiveness of calculus teaching materials-based methods in various learning environments, like various types of institutions, education, and sizes of classes.
- b. Development of More Specific Materials: Research can be focused on developing material cases that are more specific to the topic of calculus. This can improve relevance and power-pull material for participant learning.
- c. Deeper Understanding of the Effect of Case Method: Research can explore this impact in more depth using the case method to understand draft calculus and the ability to solve a problem through participant learning.
- d. Comparison with Other Teaching Methods: A comparative study between using methods case by case and teaching others can provide valuable insight about the advantages and disadvantages of each approach.
- e. Evaluation Long Term: Evaluation studies that last a long time can monitor retention and implementation of draft calculus by participants after they finish the course. This can provide a better understanding of the impact period of this teaching material.
- f. Training Teachers: Research can consider the development of training programs for teachers who will use calculus teaching materials-based methods. Support and readiness of teachers are important for successful implementation.

Study advanced in the development of calculus teaching materials based on the case can continue to increase quality and effectiveness of teaching in this lesson. With improvements in sustainability and adaptation to the needs of participants and the environment, this teaching material can become a more effective means of understanding and applying draft calculus.

**Acknowledgments.** We would like to thank the Institute for Research and Community Service (LPPM) Medan State University, Dean of the Faculty of Mathematics and Natural Sciences, State University of Medan, Department of Mathematics, Mathematics Study Program and colleagues who have assisted in carrying out this research. The heading should be treated as a 3rd level heading and should not be assigned a number.

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